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RESEARCH ARTICLE Agricultural Science Digest, Volume Issue : ()

An Economic Analysis of Technology Change in Tissue Culture and Non-tissue Culture Pointed Gourd in Anand and Kheda Districts of Middle Gujarat

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10.18805/ag.D-5541

ABSTRACT

Background: This paper has attempted an economic analysis of tissue-culture pointed gourd and non-tissue culture pointed gourd. As we know that vegetables are rich and comparatively cheaper source of vitamins. Consumption of these items provides taste, palatability and fiber for digestion. Their consumption in plenty provides fair amount of protein and also play a key role in neutralizing the acids produced during digestion of fatty foods. While pointed gourd contains 2 per cent protein, 0.3 per cent fat, 2.2 per cent carbohydrate, 153 IU vitamin A and 29 mg vitamin C per 100g edible portion (www.agrifarming.in).

Methods: This study was conducted in the year 2017-18. The study has been conducted in the Anand and Kheda districts of Middle Gujarat using personal interview method. And 4 talukas were selected. Total 80 respondents were selected, out of them 40 were cultivating non-tissue culture and 40 were cultivating tissue culture variety of pointed gourd. Cost and return analysis had been done by using cost concepts. The Garrett ranking technique was used to study the adoption behaviour of farmers.

Result: The study revealed that tissue-culture pointed gourd is more beneficial as compared to non-tissue culture pointed gourd. The cost of cultivation (Cost C_2) of pointed gourd per hectare for tissue culture and non-tissue culture was ₹ 306655 and ₹ 237216, respectively. The average yield of tissue culture and non-tissue culture pointed gourd was 483 q and 248.49 q, while gross income was ₹ 597595 and ₹ 324741 respectively. Per hectare net returns in tissue culture pointed gourd for Cost C_2 was ₹ 290940 whereas for non-tissue culture pointed gourd the per hectare net return over Cost C_2 was ₹ 87525. The overall per hectare farm business income, family labour income and farm investment income for tissue culture farmer were found to be significantly higher compared to their counterpart non-tissue culture farmers. The overall input-output ratio on Cost C_2 was 1.95 for tissue culture and 1.37 for non-tissue culture. 'Higher yield' was the main reason for adoption of tissue culture technology followed by 'high quality fruit' and 'higher income per hectare'. On the whole, the analysis has revealed that the tissue culture technology in pointed gourd cultivation can go a long way in enhancing the farmers income which is the need of the hour.

Key words: Cost concept, Non-tissue culture, Pointed gourd, Tissue-culture.

INTRODUCTION

In most of the developing countries of the world, agriculture as well as horticulture occupies an important place because of their major share in the economy in terms of their contribution to the national income and employment. In India, agriculture contributes 14 per cent to the gross domestic product and most of population in villages is still engaged in it. India is considered as basket of fruits and vegetables in the world. India's diverse climate ensures availability of all varieties of fresh fruits and vegetables. In India, the growth in agricultural and horticultural sector of the country needs to be accelerated to generate more surpluses for export in order to earn foreign exchange.

Vegetables are rich and comparatively cheaper source of vitamins. Consumption of these items provides taste, palatability and fiber for digestion. Their consumption in planty provides fair amount of protein and also play a key role in neutralizing the acids produced during digestion of fatty foods. Some of the vegetables are good sources of carbohydrates, proteins, vitamin A, vitamin B, vitamin C and minerals. As per standard norms, daily requirement of vegetables is 75 to 125 g of green leafy vegetables, 85 g of roots and tuber's and 85 g of other vegetables with other food. Vegetables are mostly consumed as fresh, cooked and in preserved forms.

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How to cite this article: Rajwadi, A. and Pundir, R.S. (2022). An Economic Analysis of Technology Change in Tissue Culture and Non-tissue Culture Pointed Gourd in Anand and Kheda Districts of Middle Gujarat. Agricultural Science Digest. DOI: 10.18805/ag.D-5541.

Submitted: 18-12-2021 **Accepted:** 10-05-2022 **Online:** 28-06-2022

Year wise scenario of vegetables in india

As per scenario, in the year 1999-00 area under total vegetables was 5991 thousand hectares which was increased up to 10292 thousand hectares in 2019-20. The

annual production in the year 1999-00 was 90823 thousand metric tons which increased up to 188009 in the year 2019-20. The productivity also increased from 15.2 to 18.2 metric tons per hectare from 1999-00 to 2019-20 (www.indiastat.com). It shows that India has made remarkable progress in the horticulture sector.

Year wise scenario of vegetables in gujarat

As per Directorate of Horticulture, area under total vegetables was 216 thousand hectares which was increase up to 644 thousand hectares with annual growth rate of 1.07 per cent from 1999-00 to 2016-17. The production of vegetables was 13161 thousand million tons which was increased up to 13161 thousand MT with annual growth rate of 1.09 per cent from 1999-00 to 2016-17. The productivity also increased from 12.63 to 20.44 metric tons per hectare with annual growth rate of 1.03 per cent from 1999-00 to 2016-17 (*www.indiastat.com*).

Pointed gourd, commonly called '*Parwal*' (*Trichosanthes dioica Roxb*.) is a perennial cucurbit cultivated mostly in Bihar, Bengal, Madhya Pradesh and Eastern Uttar Pradesh. Immature fruits of this plant are a popular vegetable. It originated from India or Indo-Malayan region. Bengal-Assam area is the primary centre of origin of pointed gourd. It contains 2 per cent protein, 0.3 per cent fat, 2.2 per cent carbohydrate, 153 IU vitamin A and 29 mg vitamin C per 100g edible portion (*www.agrifarming.in*). The fruits are used in making curry, fried and for making pickles also. A famous sweet by putting the fruits in sugar syrup is made in India. The fruit is particularly recommended during convalescence. It is easily digested and is a diuretic, laxative and cardiatonic. It is also recommended for bronchitis, biliousness, high fever and nervousness.

MATERIALS AND METHODS

Selection of study area

The Gujarat state comprises of 33 districts. The central Gujarat region of the state was selected for the study as it contributed 33.67 per cent to the total area under cucurbits cultivation in 2015-16 (http://doh.gujarat.gov.in). A two-stage stratified sampling was adopted as appropriate sampling procedure for the study.

Selection of districts

In the first stage, out of nine districts, two districts were selected purposively. Anand and Kheda were selected for the study. Comparative information from published sources at district level was not available, but according to the concerned district horticulture officers, these districts constitute maximum area under pointed gourd.

Selection of talukas

All the talukas in Anand and Kheda districts were listed along with their area of pointed gourd crop. From each selected districts, two talukas were selected purposively in consultation with taluka panchayat office. Thus, total four talukas were selected for the present study. The details about Anand district not available so on the basis of consultant of taluka panchayat office, Anand and Anklav talukas was selected. From all the talukas total 80 respondents, 40 tissue-culture farmers and 40 non-tissue culture farmers had selected.

Calculation of cost and return

Cost concepts widely used by CACP such as Cost A, Cost B, Cost C_1 and Cost C_2 was adopted for computing cost of cultivation/production of the pointed gourd. The different cost items that are included under each cost concept are detailed below with their imputational procedures.

Here, Cost A is also referred as operating cost or paid out cost and Cost C_2 is also referred as total cost.

Cost A can also be divided into two parts *viz.,* Cost A_1 and Cost A_2, if tenant farmers are there in the study. In the present study, Cost A was considered without dividing into Cost A_1 and Cost A_2 as there was no tenant farmer in the list of selected respondents

Income measures

The various income measures used in the present study are shown under.

(i) Value of gross output (Gross Income):
It is calculated by considering the total production of pointed guard in quintal and price prevailing of product per quintal.

(ii) Farm business income= Gross income minus Cost A.

(iii) Family Labour Income= Gross income minus Cost B.

(iv) Farm harvest income= Net income + Rental value of owned land + Interest on owned fixed capital.

(v) Net income (profit or loss)= Gross income minus Cost C_2.

Garrett ranking technique

The Garrett ranking technique was used to study the opinions of the farmers regarding the adoption of tissue culture technology by other farmers. The per cent position of each rank was worked out by using following equation:

$$\text{Per cent position} = \frac{100\ (R_{ij}-0.5)}{N_i}$$

Where,

R_{ij} = Rank given for the i^{th} item by the j^{th} individual.

N_i = Number of items ranked by the j^{th} individual.

The per cent position of each rank is converted into scores by referring to the Table given by Garrett and Woodworth (1971).

RESULTS AND DISCUSSION

It has been showed in Table 1 that on an overall basis, share of Cost A, Cost B and Cost C_1 accounted for about 65.95, 85.90 and 90.91 per cent of Cost C_2, respectively for tissue culture technology. Whereas share of Cost A, Cost B and Cost C_1 accounted for about 64.43, 84.65 and 90.91 per cent of Cost C_2, respectively for non-tissue culture technology. The per hectare Cost C_2 for tissue culture and non-tissue culture was ₹ 306655 and ₹ 235561 respectively. Cost of tissue culture technology was higher as compared

to non-tissue culture technology. This is in agreement with the finding of earlier studies conducted by Alagumani (2005), Sivanagaraju (2006), Hanumantharaya *et al*. (2009) and Rama Rao (2012).

Yield, weighted average price and gross income of pointed gourd

Table 2 revealed that on an average yield of tissue culture pointed gourd was higher (483 quintals) then non-tissue culture pointed gourd (248.49 quintals) per hectare. The per quintal average weighted price for tissue culture was ₹ 1236 and for non-tissue culture it was ₹ 1307. The overall average gross return per hectare on tissue culture pointed gourd farms amounted ₹ 597595 and for non-tissue culture pointed gourd farms it was amounted ₹ 324741. The result seems to be very well in componence with those obtained by Radha *et al*. (2009) in SRI method in their study.

Net returns over different costs

A perusal of Table 1 shows that per hectare net returns in tissue culture pointed gourd for Cost C_2 was ₹ 290940 whereas for non-tissue culture pointed gourd the per hectare net return over Cost C_2 was ₹ 87525. The above observations are similar with the observation made by Bairwa *et al*. (2015) and Haldar *et al*. (2012).

Farm business income, Family labour income, Farm investment income and net income

Table 3 shows overall per hectare farm business income, family labour income and farm investment income for tissue culture farmer were found to be ₹ 395352, ₹ 334175 and ₹ 351844, respectively. Whereas for non-tissue culture farmer, per hectare farm business income, family labour income and farm investment income were found to be ₹ 181893, ₹ 123929 and ₹ 135489.

Input-output ratios

From cost benefit analysis input-output ratio was worked out and presented in the Table 1. The overall input-output ratio was more in tissue-culture technology (1.95) on the basis of total cost (Cost C_2) than that of in non-tissue culture technology (1.37). The input-output ratio for Cost A was more in tissue-culture technology (2.95) than that of in non-tissue culture technology (2.12). The input-output ratio for Cost B was more in tissue-culture technology (2.27) than that of in non-tissue culture technology (1.62). Similarly, Shanmugasundaram and Helen (2015) and Shende *et al*. (2017) also found higher B-C ratio in SRI method than that of in traditional method.

On the whole, based on cost and return analysis it can be concluded that tissue culture pointed gourd cultivation was highly remunerative compared to non-tissue culture pointed gourd cultivation.

Reason for adoption of tissue culture technology

Table 4 shows the reasons for adoption of tissue-culture technology were identified by the respondents, 'higher yield' was ranked first as tissue-culture technology got higher yield from pointed gourd crop. 'Higher quality grain' was ranked second, as the farmer in tissue-culture method got higher quality grain from pointed gourd crop in tissue-culture technology. The third rank was given to 'Higher income per hectare' as they observed that in tissue-culture technology, higher net income per hectare compared to that in non-tissue culture technology.

Constraint in adoption of tissue culture technology

Table 5 shows the major production constraint was 'Weather condition' ranked first as it was observed that weather of central Gujarat is not much favourable for tissue-culture plantlet due to high temperature in the month of May. 'Higher cost of plantlet' was ranked second, as in tissue-culture technology farmer had to pay higher price for plantlets as compared to non-tissue culture plantlets. The third rank was given to 'Unavailability of tissue-culture plantlets' as it was observed that tissue-culture plantlet cannot be grown easily in normal weather condition it required specific controlled environment so for growing plantlets in initial stage laboratory was required and plantlet was available where laboratory was nearer to farmer. These findings are in line with the observations made by earlier studies of Sita Devi and Ponnarasi (2009).

Reasons for non-adoption of tissue culture technology

Table 6 shows the respondents of the non-tissue culture pointed gourd grower reported four reasons for not adopting the tissue-culture technology. They ranked 'Lack of awareness' as the foremost reason for not adopting tissue-culture on their farms. 'Lack of experience' was ranked second. 'Lack of extension service' was ranked third followed

Table 1: Estimation of different costs.

Different costs	Costs of cultivation (₹/ha)		Net return over costs (₹/ha)		Input-output ratios over different costs	
	Tissue culture	Non tissue culture	Tissue culture	Non tissue culture	Tissue culture	Non tissue culture
Cost A	202243 (65.95)	152848 (64.43)	395352	171893	2.95	2.12
Cost B	263420 (85.90)	200812 (84.65)	334175	123929	2.27	1.62
Cost C_1	278777 (90.91)	215651 (90.91)	318818	109090	2.14	1.51
Cost C_2	306655 (100.00)	237216 (100.00)	290940	87525	1.95	1.37

Source: Field Survey.

Note: Figure in parenthesis indicate percentage to Cost C_2.

Table 2: Yield, weighted average price and gross income of pointed gourd. (Per hectare).

Particulars	Category of farmer	
	Tissue culture	Non tissue culture
Yield (q)	483	248.49
Weighted average price (₹/q)	1236	1307
Gross Income (₹)	597595	324741

Source: Field survey.

Table 3: Farm business income, family labour income, farm investment income and net income. (₹/ha)

Particular	Category of farmer	
	Tissue culture	Non-tissue culture
Farm Business Income	395352	181893
Family Labour income	334175	123929
Farm Investment Income	351844	135489
Net Income	290940	87525

Source: Field survey.

Table 4: Reasons for adoption of tissue-culture technology.

Reason for adoption of tissue culture technology	Per cent position	Score	Rank
Higher yield	14.88	71	I
High quality fruit	32.13	59	II
Higher income per hectare	64.13	43	III
More numbers of picking	76.88	36	IV
Low pest and disease incidence	90.00	24	V

Source: Field survey.

Table 5: Constraints in adoption of Tissue-culture technology.

Constraint in adoption of tissue culture technology	Percent position	Score	Rank
Weather condition	12.27	73	I
Higher cost of plantlet	39.04	55	II
Unavailability of tissue culture plantlet	51.68	49	III
Unavailability of implements	72.00	38	IV
More labour requirement	89.06	26	V
Difficulty in planting	90.21	23	VI

Source: Field survey.

Table 6: Reason for non-adoption of tissue-culture technology.

Reason for non-adoption of tissue culture technology	Per cent position	Score	Rank
Lack for awareness	20.63	66	I
Lack of experience	43.83	53	II
Lack of extension service	75.80	36	III
Lack of training	69.62	40	IV

Source: Field survey.

by 'Lack of training'. These findings are in line with the observations made by earlier studies of Sita Devi and Ponnarasi (2009).

CONCLUSION

The study has shown that tissue-culture pointed gourd was more profitable as compared to non-tissue culture pointed gourd. The net return per hectare for was higher in tissue culture farms (₹ 290940) as compared to non-tissue culture farms (₹ 87525). The overall per hectare farm business income, family labour income and farm investment income for tissue culture farmer were found to be ₹ 395352, ₹ 334175 and ₹ 351844, respectively. Whereas for non-tissue culture farmer, per hectare farm business income, family labour income and farm investment income were found to be ₹ 181893, ₹ 123929 and ₹ 135489. The total cost of production (Cost C_2) per quintal of tissue culture pointed gourd was ₹ 634 and for non-tissue culture pointed gourd per quintal total cost (Cost C_2) was ₹ 955 on sample farms. The overall input-output ratio was more in tissue-culture technology (1.95) on the basis of total cost (Cost C_2) than that of in non-tissue culture technology (1.37). Higher yield was the main reason for adoption of tissue culture technology followed by high quality fruit and higher income per hectare.

The constraints in adoption of tissue culture technology were ranked by respondents, they ranked 'weather condition' first followed by 'higher cost of plantlet' and 'unavailability of tissue culture plantlet'. The reason for non-adoption of tissue culture technology was 'Lack of awareness' as the foremost reason for not adopting tissue-culture by farmers.

SUGGESTIONS

As productivity and net profit found to be higher in tissue culture than that in non-tissue culture method, it is required to popularize tissue culture technology among farmers of the state. The government and extension agencies need to encourage the widespread adoption of tissue culture cultivation. Government may even provide incentives by way of subsidies or in other forms for promotion of this technology.

It is also suggested that tissue culture cultivation giving double income as compared to non-tissue culture cultivation so we can suggest the farmer for growing tissue culture pointed gourd.

Conflict of interest: None.

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